

# Methods for the Best Evidence Synthesis on Neck Pain and Its Associated Disorders

## The Bone and Joint Decade 2000–2010 Task Force on Neck Pain and Its Associated Disorders

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**Study Design.** Best evidence synthesis.

**Objective.** To provide a detailed description of the methods undertaken in a systematic search and perform a best evidence synthesis on the frequency, determinants, assessment, interventions, course and prognosis of neck pain, and its associated disorders.

**Summary of Background Data.** Neck pain is an important cause of health burden; however, the published in-

formation is vast, and stakeholders would benefit from a summary of the best evidence.

**Methods.** The Bone and Joint Decade 2000–2010 Task Force on Neck Pain and its Associated Disorders conducted a systematic search and critical review of the literature published between 1980 and 2006 to assemble the best evidence on neck pain. Citations were screened for relevance to the Neck Pain Task Force mandate, using *a priori* criteria, and relevant studies were critically reviewed for their internal scientific validity. Findings from studies meeting criteria for scientific validity were synthesized into a best evidence synthesis.

**Results.** We found 31,878 citations, of which 1203 were relevant to the mandate of the Neck Pain Task Force. After critical review, 552 studies (46%) were judged scientifically admissible and were compiled into the best evidence synthesis.

**Conclusion.** The Bone and Joint Decade 2000–2010 Task Force on Neck Pain and its Associated Disorders undertook a best evidence synthesis to establish a baseline of the current best evidence on the epidemiology, assessment and classification of neck pain, as well as interventions and prognosis for this symptom. This article reports the methods used and the outcomes from the review. We found that 46% of the research literature was of acceptable scientific quality to inform clinical practice, policy-making, and future research.

**Key words:** neck pain, systematic review, epidemiology, assessment, treatment, prognosis.

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Over the past 2 decades, there has been an explosion of studies on neck pain. This speaks to the growing recognition of the personal and societal burden associated with this problem. It also suggests that clinicians, researchers, and policy-makers may be finding it difficult to keep up with this vast literature.

In 1995, the Québec Task Force on Whiplash-Associated Disorders released the first systematic review of the literature on whiplash injuries. That endeavor produced a baseline of the information on the subject.<sup>1</sup> However, that group's mandate was focused specifically on whiplash injuries and did not permit consideration of neck pain resulting from occupational injuries/strains, or consideration of neck pain in the general population. It is

also important to note that much new data on whiplash has been published in the intervening 12 years.

The authors of the 1995 Québec Task Force suggested that the next review of the literature should take place within 5 years. In 2000, we assembled an international task force of scientist/clinicians and methodologists, under the auspices of the Bone and Joint Decade 2000–2010. The mandate of the Bone and Joint Decade 2000–2010 Task Force on Neck Pain and its Associated Disorders (Neck Pain Task Force) was to make recommendations that would culminate in reducing the medical, social, and economic consequences of neck pain and its associated disorders.

To fulfill this mandate, the Neck Pain Task Force undertook 2 phases of investigation: (1) a systematic search, critical review, and synthesis of the literature on neck pain and its associated disorders (best evidence synthesis) and (2) original research on neck pain. A 12-member working group, the Scientific Secretariat, performed the scientific work of the Neck Pain Task Force. This work was supplemented by collaboration with special consultants and research associates for specific projects, and was overseen by an Advisory Committee, made up of scientists, clinicians, and methodologists from around the world, who provided guidance and expert opinion on clinical and methodological issues.

The purpose of the literature search was to identify all relevant literature on the incidence, prevalence, assessment and classification, course, natural history, prognostic factors, and interventions for neck pain its associated disorders, that is, those disorders that are thought to be directly associated with nonspecific neck pain. For example, studies of headaches were included if it dealt with cervicogenic headache, but not included if it dealt with non-neck-related headaches.

The following questions were addressed in this best evidence synthesis:

- What is the epidemiology of neck pain and its associated disorders? What is the risk of developing neck pain because of work-related injury or strain, motor vehicle injuries, and other nonspecific etiologies? What are the determinants of the problem?
- How can neck pain be prevented?
- What are the most reliable and valid strategies and technologies for assessing neck pain?
- What is the course of neck pain of various etiologies? What is the prognosis for recovery? What are the determinants of recovery, persistence, and worsening of neck pain?
- What is the evidence regarding interventions for neck pain and its associated disorders? What are the associated harms and the intended benefits?

## ■ Materials and Methods

### Literature Search

The scientific literature published in 1980–2006 was searched. Seminal papers published before 1980 were identified by Neck

Pain Task Force Scientific Secretariat members in consultation with professional groups and the Neck Pain Task Force Advisory Committee. These were included in the critical review process.

**Electronic Literature Database.** The primary source of literature was citations indexed in the electronic library database, Medline between the years 1980 and 2005. The search was updated (update procedures described below) for articles published in 2006 and early 2007. The search strategy was developed by content experts on the Scientific Secretariat (L.J.C., J.D.C., P.P.), with the assistance of library and information scientists familiar with electronic health databases (L.G.-S., S.W.G., C.S.C.). The search strategy used thesaurus terms (referred in Medline as Medical Subject Headings or MeSH terms) and text words to ensure that all relevant studies were identified in our search.<sup>2</sup> In brief, we used MeSH terms such as “neck pain,” “neck injuries,” and “intervertebral disc,” supplemented by text words, such as “cervical pain,” “neckache,” and “whiplash.” All identified citations were entered into a bibliographic management software program called Reference Manager. Full details of the search terms and strategy can be viewed at ([link to url site](#)).

### Screening for Relevance to Neck Pain Task Force Mandate.

The electronic literature search was by design comprehensive (sensitive) but not specific. Therefore, only a minority of citations identified *via* the search were judged to be relevant to the Neck Pain Task Force mandate. All citations identified in the electronic search were then screened again for relevance using the same *a priori* defined inclusion and exclusion criteria, as follows.

**Inclusion Criteria for Full-Length Manuscripts.** Studies were included if they were published since 1980 till date. Articles published before 1980 could be included if they were studies that continue to have a substantial impact on clinical practice or they are cited consistently in current research reports (seminal papers).

English, French, and Swedish language original research manuscripts and systematic reviews/meta-analysis, published in peer-reviewed journals were included, as were conference proceedings, technical reports, unpublished manuscripts, and book chapters with original data.

Study reports with findings relevant to neck pain with or without its associated disorders (*e.g.*, arm pain radiating from the neck; upper thoracic pain, headache, and temporomandibular joint pain associated with neck pain) were included.

Studies that examined the risk for neck pain were included; as were studies looking at the assessment, prevalence, incidence, interventions, rehabilitation, course, prognosis, prevention or economic cost of neck pain with or without its associated disorders.

Scientific guidelines specific to the assessment or treatment of neck pain with or without its associated disorders were included.

Clinical case series were included if they were judged to be of special relevance to the Neck Pain Task Force report (*e.g.*, if they were frequently cited in the literature, recommended by a member of the Scientific Advisory Board or professional society, if they might contribute evidence of safety of interventions, and/or if they were on a topic for which there was little or no other information available from reports involving greater methodological rigor).

**Exclusion Criteria.** Studies were excluded if they did not include at least 20 human subjects with neck pain, or 20 subjects at risk of neck pain.

Studies were excluded if they were about neck pain that was associated with serious local pathology or systemic disease, such as neck pain from infections; fractures or dislocations; myelopathy; rheumatoid arthritis and other inflammatory joint diseases; or tumors. An exception to this was diagnostic studies relating to ruling out fractures and dislocations in neck pain, which were included in the critical review for assessment of neck pain.

Studies about disorders not associated with neck pain were excluded.

Opinion articles, letters to the editor, and articles without scientific data or a report of their methodology were excluded.

Studies were excluded if they contained no neck pain-specific data (*e.g.*, if all the findings in the study combined neck and back pain, with no separate findings reported for neck pain).

Case series (except as indicated in the inclusion criteria) and nonsystematic review articles were excluded.

Clinical guidelines not specific to neck pain with or without its associated disorders were excluded. Guidelines without details of their methodology were also excluded.

Studies using cadavers or nonhuman subjects, such as crash test dummies and animals were excluded, as were laboratory simulations.

Each citation (usually title and abstract) found in the literature search was reviewed by 3 members of the Neck Pain Task Force Secretariat, in rotating groups. The citation was deemed probably relevant, irrelevant, or unknown based on the agreement of at least 2 of the 3 members. No attempt was made to evaluate scientific quality of the study at the abstract screening stage.

- A study was considered probably relevant if the information contained in the abstract indicated that it met the above inclusion/exclusion criteria.
- If the abstract was unavailable or there was insufficient information provided to determine its relevance, a study was considered unknown.
- If information provided about the study clearly indicated that it did not meet the above inclusion/exclusion criteria, it was deemed irrelevant.
- Where there was no agreement among raters, or where one rater considered the study to be probably relevant, the relevance of that citation was decided *via* a face-to-face meeting of the entire scientific Secretariat.
- All studies considered to be of probable or unknown relevance were obtained as a full manuscript from the library and the entire article was screened again for conformity with the inclusion/exclusion criteria.
- Case series were identified and, if they were not judged to be of special relevance to the Neck Pain Task Force report, were excluded at this point. The decision to exclude most case series from our critical review process was based on 2 key factors: although the presence of an association can be surmised from such studies, the magnitude of that association cannot be ascertained<sup>3</sup>; also, treatment effectiveness/efficacy cannot be properly ascertained without a control or comparative group. Such studies are more useful in suggesting hypotheses to be tested using stronger study designs; or in alerting clinicians to the presence of adverse effects of interventions.

As an adjunct to searching the Medline database, we also examined reference lists of all relevant studies to identify potentially relevant studies that might have been missed. All articles obtained in this way were subjected to the same relevance screening.

**Updating the Literature Review.** We did not systematically or formally search Medline for articles published in 2006 or 2007. However, we included articles published in 2006 or early 2007 if they were judged to inform our findings. This would apply to randomized controlled trials, large longitudinal studies, those studies that addressed issues for which prior studies had produced little or no evidence, and those identified as important articles by individual Scientific Secretariat members.

### **Critical Review of the Literature**

All studies found during the literature search, which were judged relevant to the Neck Pain Task Force mandate, were subjected to a process of critical review and subsequent data abstraction. These critical reviews were performed by the Scientific Secretariat and assessed each study's scientific quality, with an emphasis on its internal scientific validity and its clinical relevance to the Neck Pain Task Force mandate. We used *a priori* criteria and computerized critical review forms, modified from the review forms used by the Québec Task Force on Whiplash-Associated Disorders<sup>1</sup> and the WHO Collaborating Centre for Neurotrauma, Prevention, Management, and Rehabilitation Task Force on Mild Traumatic Brain Injury.<sup>4</sup> The critical review forms were used as a guide to identify methodological strengths and sources of bias, and to facilitate the Scientific Secretariat's discussions of the methodological and clinical features of each study.

The methodological critique focused on assessing the presence of selection bias, information bias and confounding, and any impact these might have on the study's internal validity. Issues of external validity (generalizability) were also considered during the review process. There was no attempt to provide a rating scale cutoff or quantitative score for judging scientific acceptability. Instead, the forms were used to abstract information from the study and to focus commentary on the presence or absence of important methodological issues.

Thus the critical review forms prompted the reviewers to focus on issues of study design, study population, issues related to the conduct of the study, participation rates, follow-up rates where relevant, measurement issues, and statistical analysis. These key quality measures were derived from fundamental principles of epidemiological conceptualization, measurement, and design, and are consistent with best research practices. For example, the criteria we used to appraise randomized controlled trials are consistent with the CONSORT statement<sup>5,6</sup>; those used to evaluate cohort studies are consistent with the TREND recommendations<sup>7</sup>; and those used to evaluate diagnostic studies are consistent with the STARD initiative.<sup>8</sup> These critical appraisal review forms are available online through Article Plus. These review forms were programmed on an Access database and each scientific critical review was completed and archived electronically.

The Scientific Secretariat was divided into teams for the purpose of reviews; relevant articles were divided equally among these teams. Membership in these review teams rotated periodically, with attention paid to balancing methodological and clinical expertise. Within each review team, pairs of Scientific Secretariat members performed independent in-depth reviews of each article. The team discussed the internal validity and clinical merits of each study, making a decision about the

study's admissibility for the best evidence synthesis. In addition to identifying selection bias, information bias, and confounding, the Neck Pain Task Force Scientific Secretariat members also considered the likely impact of a study's identified methodological limitations on the findings, for example, whether a particular identified bias would be more likely to have produced artificially high or artificially low estimates. This discussion originally involved the entire Scientific Secretariat; however, as members gained experience and the reviews were performed more consistently, discussions of methodological quality and scientific merit were relegated to smaller groups.

Studies were deemed inadmissible if the review team agreed that scientific validity was markedly compromised because of biases and methodological flaws. Those studies judged as having adequate internal validity were included in the Best Evidence Synthesis. If agreement on scientific admissibility into the Best Evidence Synthesis could not be reached, the study was brought before a meeting of the full Scientific Secretariat for discussion. Where necessary, the advice and expertise of Advisory Committee members were sought.

In some cases, partial findings from an article might be deemed as providing valid evidence (*e.g.*, findings from short-term follow-up of patients). However, other findings from the same study might be considered too flawed to accept (*e.g.*, findings from long-term follow-up where high rates of attrition may mean a greater likelihood of bias). Where estimates of effect size and measures of variability were not provided by the study authors, but where this information was judged to be of importance and could be calculated, the Neck Pain Task Force did so. These calculations were included in the evidence tables (described below).

If the author or coauthor of an article was also a Scientific Secretariat member, this person did not review his or her own manuscripts, nor was the member in attendance during the presentation and discussion of the article.

### Evidence Tables

Each study included in the best evidence synthesis related to one or more the following areas involving neck pain and its associated disorders:

- Incidence and risk factors for onset of neck pain; prevalence and factors associated with prevalent neck pain; prevention of neck pain
- Assessment and diagnosis
- Interventions and rehabilitation; economic costs; health care utilization
- Course (natural history) of neck pain and prognostic factors.

Data from those studies judged as scientifically admissible were then abstracted into evidence tables relating to each of these topics. If a study was related to more than one topic, it was included in more than one set of evidence tables. The evidence tables formed the basis for the review on each topic. (Note: The evidence tables themselves are too lengthy to be included in this published document. They are cited within each article, and available online through Article Plus.)

### Analysis

We synthesized the literature according to the principles of best evidence synthesis.<sup>9,10</sup> This consists of a qualitative synthesis of the studies judged to be scientifically admissible. The process for this type of data synthesis is outlined in detail elsewhere.<sup>11</sup>

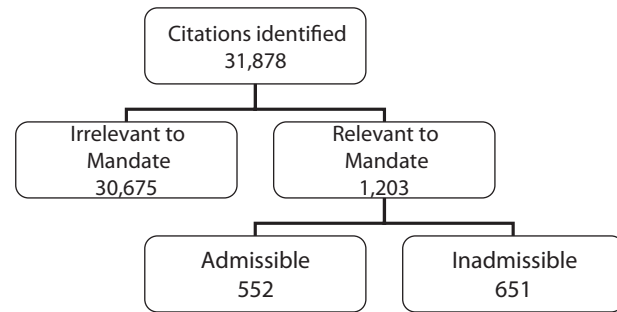


Figure 1. Results of the literature search and critical review.

Briefly, writing teams made up of Neck Pain Task Force Scientific Secretariat members used the evidence tables as a basis for outlining the best evidence on each topic, identified consistencies and inconsistencies in this evidence, and formulated summary statements describing this evidence. Where findings across studies varied, an attempt was made to provide potential explanations for such discrepancies. Within those studies judged scientifically admissible, more emphasis was given in these summary statements to evidence from those studies whose designs and conduct were judged to be the least vulnerable to bias. Specific criteria for making these judgments were dependent on the research question and the research design, and is presented at more length in each of the best evidence synthesis articles.<sup>12–20</sup>

The summary statements in each separate review were then discussed and debated by the Scientific Secretariat as a whole, and conclusions were endorsed by all members of the Scientific Secretariat.<sup>21,22</sup>

## Results

A total of 31,878 citations were identified in Medline. After applying our inclusion/exclusion criteria to these studies and those identified in our other search strategies, 1203 studies were deemed relevant to the Neck Pain Task Force mandate and were therefore subjected to the critical review process. Of these, 552 (46%) were accepted as scientifically admissible, and comprise the Best Evidence Synthesis (Fig. 1). A breakdown of critically appraised studies by topic area, and the number of articles rated as admissible are reported in Table 1.

**Table 1. Number of Appraised and Admissible Studies on Neck Pain and Its Associated Disorders, by Topic Area**

| Topic Area                           | No. Studies Critically Appraised* | No. (%) Studies Accepted as Scientifically Admissible* |
|--------------------------------------|-----------------------------------|--|
| Incidence/risk/prevention/prevalence | 469                               | 249 (53)   |
| Assessment and diagnosis             | 274                               | 95 (35)  |
| Course/prognosis                     | 226                               | 70 (31)  |
| Interventions                        | 359                               | 170 (47)   |
| Economic costs                       | 14                                | 13 (93)  |

\*Some studies relate to more than one topic and are included in this table more than once.

## ■ Discussion

We performed a systematic search of published literature on neck pain and its associated disorders. These studies were then screened for relevance to the Neck Pain Task Force mandate using *a priori* defined inclusion/exclusion criteria. Those deemed to be relevant to the mandate were subjected to a critical review. We performed critical reviews on 1203 studies, and of these, a total of 552 studies were judged as having sufficient internal validity, and comprise the list of studies available for our best evidence synthesis.

It might be argued that our search methodology was limited by (1) not including electronic library databases other than Medline (*e.g.*, EMBASE), and (2) the fact that we included only English, French, and Swedish language studies. Our decision to limit our search to studies contained in Medline was primarily a practical one. However, there is evidence that Medline captures the vast majority of studies. One example involves a best evidence synthesis on mild traumatic brain injury conducted for a task force similar to ours. After a literature search that included Medline, PsycINFO, EMBASE, and CINAHL, it was determined that Medline contained 90% of all relevant studies on that topic.<sup>23</sup> To confirm that this is also likely true in the neck pain literature, we arbitrarily chose 2 years (2000 and 2004) and calculated the duplication between EMBASE and Medline. We found that over 95% of the citations contained in EMBASE for each of those years (and relevant to the Neck Pain Task Force mandate) were also contained in Medline.

The Neck Pain Task Force's decision about restricting the search to articles written in English, French, and Swedish was also based primarily on practical considerations, mainly the potential cost of translating articles published in a variety of languages weighed against uncertain gain. Therefore, we included only articles written in languages spoken and/or read by at least 2 members of the Scientific Secretariat. Our decision to restrict studies by language is partially supported by evidence suggesting that excluding non-English clinical trials from a meta-analysis does not result in biased results.<sup>24</sup>

We consider our approach to best evidence synthesis to be one of our key methodological strengths. We chose to use a dichotomous rating strategy (admissible/nonadmissible) rather than including all studies relevant to the topic, regardless of their quality; or, alternatively, imposing a quality rating scale to determine which studies to include. It has been demonstrated that combining findings from studies without considering the impact of their methodological quality can result in bias.<sup>25,26</sup> Despite the popularity of quality rating scales, recent evidence suggests that quality scores may not be the optimal way of assessing study quality.<sup>27–29</sup> This is an important consideration, because it has been recently demonstrated that the methodology for assessing study quality in systematic reviews (best-evidence synthesis *vs.* the Cochrane Back

Review Group Guidelines) has an impact on the conclusions reached.<sup>11</sup>

In summary, we performed a comprehensive, sensitive search for literature, primarily using as our data source those articles published in journals indexed in Medline, which yielded 31,878 citations. Of these, 1203 were relevant to the Neck Pain Task Force mandate. After a critical review of these articles, we finally accepted 552 (46%) as having sufficient scientific validity to be included in our best evidence synthesis. We present these findings in 9 topic-specific reviews.<sup>12–20</sup> In addition, we identified clinical implications of the evidence,<sup>22</sup> and research implications.<sup>31</sup>

## ■ Key Points

- Neck pain is an important personal and societal burden.
- The Bone and Joint Decade 2000–2010 Task Force on Neck Pain and its Associated Disorders conducted a systematic search, critical review, and synthesis of the best evidence on neck pain.
- We found 1203 relevant studies and accepted 552 (46%) for their scientific merit. These studies comprise our best evidence synthesis on the epidemiology, assessment and classification, interventions, course, and prognosis of neck pain.



document

Appendices available online through Article Plus.

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